# Monitoring for Engine Horsepower

## Background

Many natural gas compressor engines have been permitted at horsepower values that are not consistent with the current bureau policy for horsepower deration. A number of these engines have been permitted with physical constraints (governor seals, rpm limit kill switches, etc.) that lower the maximum RPM and thus limit the maximum available horsepower of the engine. However, some engines that have a physical RPM limit are still permitted at a horsepower that is below the maximum available horsepower at the lower RPM limit. This means that a compressor engine could utilize the remaining available horsepower without exceeding the RPM physical constraints. Therefore, physical RPM limitations are not adequate to assure compliance with the permitted horsepower or emission limits since emissions are directly related to horsepower.

Note that in some cases the compressor can accept no more than a specified maximum horsepower and RPM from the engine due to the design of the compressor or due to a transmission device (torque limiter) between the engine and compressor. This guidance does not address the situation where the engine is providing these maximum amounts.

Three monitoring options, depending on the specific operating conditions of the engine, can be utilized as a supplement to the existing RPM limitations:

A. Engine fuel flow monitoring is only an option when an engine burns pipeline quality gas. This is due to the non-fluctuating btu content of pipeline gas and thus the relatively small variations in gas flowrate.

B. Monitoring manifold temperature and absolute pressure is the second option since these two variables should maintain a steady proportional relationship and can be directly related to engine horsepower.

C. Monitoring the gas flowrate and compression ratio is the third option since these variables are directly related to a theoretical horsepower requirement and can be directly correlated to the actual engine horsepower.

Manifold temperature and absolute pressure are already being measured and recorded at many Title V facilities and therefore would not be unduly burdensome for many facilities. However, if a facility does not currently measure these parameters, a complete data recording system capable of measuring temperature and pressure for six engines would cost less than $2000.00 and would require no external A.C. power. Manifold temperature and absolute pressure correlations may be established for one engine in a group of identical (same make and model number) engines. The correlations for the one engine should not be used as a tightly enforceable condition due to the variability of the parameters and engines. However, the correlation shall be used to monitor trends in the data such as the general assumption that manifold temperature and absolute pressure tend to vary proportionally.

Gas flowrate and the compression ratio are already being measured and recorded at many Title V facilities and therefore would not be unduly burdensome for many facilities. However, if a facility does not currently measure these parameters, a complete data recording system capable of measuring the gas flowrate and the inlet and outlet pressure of the facility would cost less than $2000.00 and would require

no external A.C. power. Gas flowrate and compression ratio shall be correlated to a facility wide available horsepower. Increases in one or both of the parameters shall be deemed to be out of compliance with the permitted horsepower limit. An increase in one and a decrease in another parameter will require further study to determine compliance.

**Monitoring Requirements:**

**Pipeline Quality Natural Gas**

For engines operating at a horsepower that is below the maximum available horsepower at the permitted RPM and is not limited by any physical constraint, a bi-weekly reading of engine fuel consumption is required. This means that every two weeks the fuel consumed by the facility or engine over the previous two weeks will be recorded.

The permittee shall establish a correlation of fuel gas flow to engine horsepower within 120 days of permit issuance.

**Field Natural Gas**

For engines operating at a horsepower that is below the maximum available horsepower at the permitted RPM and is not limited by any physical constraint, the permittee shall measure intake manifold temperature and absolute pressure every two hours, **or** measure the gas flowrate in cubic feet per hour (cfh) and the compressor inlet and outlet pressure every two hours.

The permittee shall establish a correlation between actual engine horsepower; manifold temperature and absolute pressure within 120 days of permit issuance. Correlations can be developed using manufacturer's data or by direct measurement of temperature and absolute pressure at a verified engine horsepower at six (6) ambient air temperatures. The manifold temperature and absolute pressure shall be recorded at a horsepower value that is within 20 percent of the permitted horsepower and at ambient air temperatures between 0º F and 100º F in increments of 5º F.

The permittee shall establish a correlation between actual engine horsepower, gas flowrate, and compression ratio, within 120 days of permit issuance. The gas flowrate and compressor inlet and outlet pressure shall be recorded at a horsepower value that is within 20 percent of the permitted horsepower.

**Record Keeping**

Fuel consumption, or engine manifold temperature and absolute pressure, or facility gas flowrate and compression ratio shall be recorded at least every two hours.

Correlation test data shall remain on file indefinitely.

**Reporting**

Correlation test data shall be submitted to the department upon completion of testing

Fuel consumption data shall be reported as a bi-weekly data point showing an average bi-hourly rate. The bi-weekly rate shall be graphed over a six-month period. Fuel consumption on the y-axis and 13 bi-weekly time periods on the x-axis.

Manifold temperature and absolute pressure bi-hourly values shall be graphed on the same graph over a six-month period. Each graph shall contain no more than 100 hours of data. Temperature on one y-axis, pressure on another y-axis and hours on the x-axis.

Bi-hourly values of gas flowrate in cubic feet per hour and the compression ratio shall be graphed on the same graph over a six-month period. Each graph shall contain no more than 100 hours of data. Gas flowrate on one y-axis, compression ratio on another y-axis and hours on the x-axis.

All data may be submitted on a computer disk or a hard copy.

# MONITORING FOR IC ENGINES (Supplemental)

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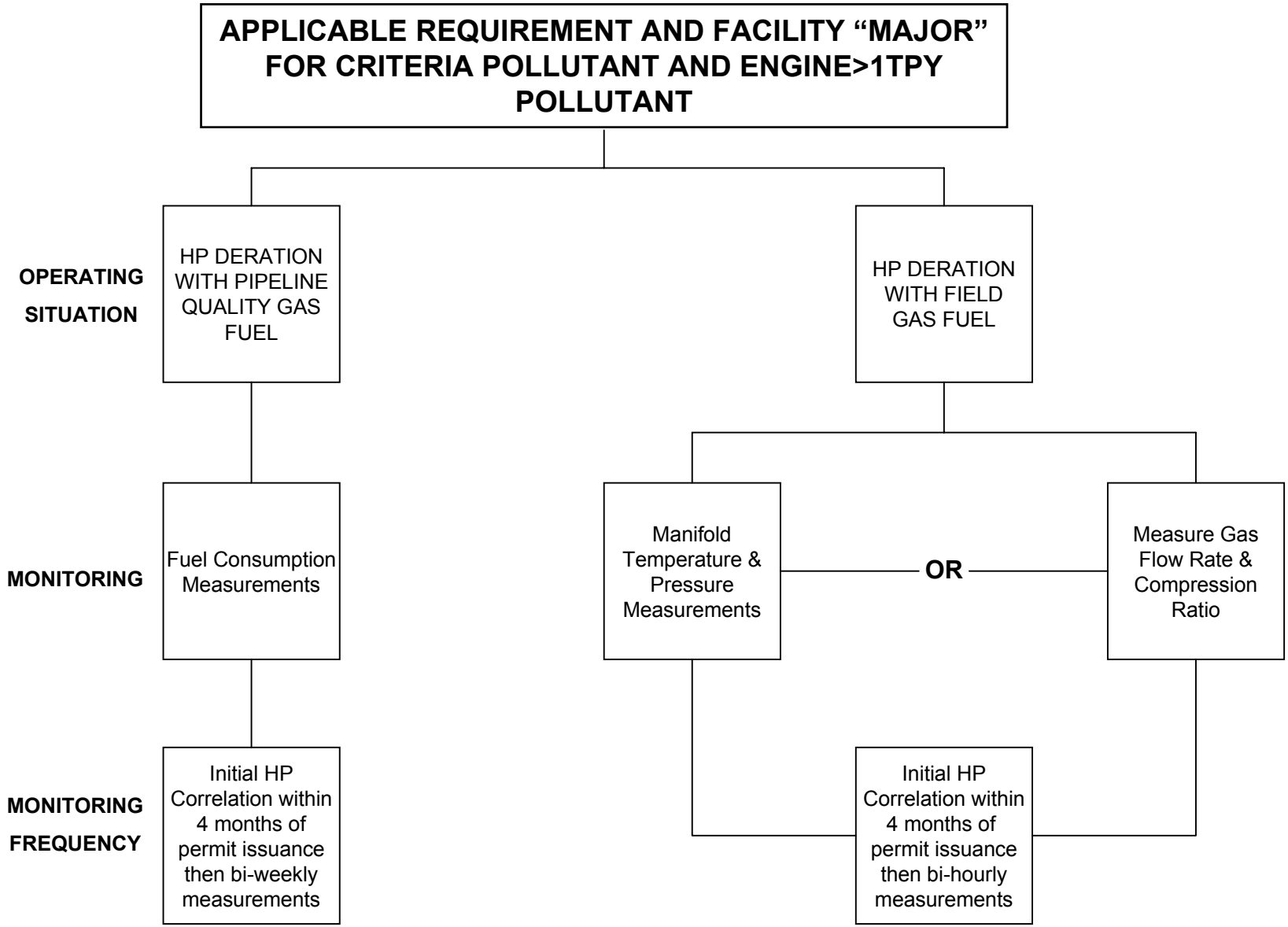


**NOTE: If more than one operating situation applies to an engine, monitoring requirements may be combined.**